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AUTHOR Andersson, Alf; Bengtsson, Margot
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ABSTRACT

A project was undertaken at the University of Lund in Sweden to study the following two problems: identification and style of problem-solving in relation to the choice by women of arts subjects and science subjects respectively at the university; and identification and style of problem-solving in relation to research focus and research ability. The initial purpose of the project was to investigate whether the proposed model of cognitive growth and development is a viable frame of reference and explanatory system for the description of an identity apprehension transcending the sex roles and of reactive, cognitive functioning. The model presented is aimed at expanding the paradigm of sex role learning and sexual identity development beyond both the level of conventional, stereotype, concrete operations and the level of formally logical operations to include a dialectical level at which the individual is free to use both "male" and "female" attitudes. Analogies are drawn to the stage of hypothetical constructions described in a model of the dialectics of cognitive development. In both models, this level is described as dialectical; i.e., the individual is relatively free to employ both objectivizing and subjectivizing cognitive modes. Preliminary results suggest that the science group has a greater predominance of individuals orienting themselves towards objects or non-self-related factors in their field of experience, while the arts group includes more individuals orienting towards subjects or self-related factors. (SW)

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CURRENT PROJECT

TITLE OF PROJECT

IDENTIFICATION AND PROBLEM SOLVING STYLE IN RELATION TO CHOICE OF SUBJECT, DIRECTION OF RESEARCH AND RESEARCH APTITUDE

IN PROGRESS AT

The Department of Applied Psychology and
The Department of Psychology
University of Lund
Paradisgatan 5
S-223 50 LUND
SWEDEN
Tel no: 046-12 41 00

SCIENTIFIC LEADER

Associate Professor Alf Andersson

PROJECT LEADER

Margot Bengtsson, psychologist

BACKGROUND

Previous studies in Lund and Gothenburg have shown that scientists and arts students at graduate level have different styles of problem solving (Bengtsson & Lundmark, 1973, 1974). Arts students prefer a "divergent" approach to problems while scientists prefer a more "convergent" approach. The concepts of "divergent" and "convergent" approaches are derived from J P Guilford's model of intellectual function (Guilford, 1967). The tests used to define these concepts are not identical with Guilford's but appear to measure the same functions on the whole. The term "divergent" thinking (as used by Guilford) denotes ability to find many different solutions to a problem. Guilford argues that this ability is fundamentally

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important to creative cognitive activity. "Convergent" thinking denotes ability to find a single correct solution to a problem. According to Guilford, this approach to problems is vitally important in "intelligent" cognitive functioning. We also found that problem solving style was related to personal style, i e to more general characteristics of the individual. This means that Guilford's model is insufficient. A better alternative might be a model paying more regard to cognitive growth and development.

THEORETICAL AND EMPIRICAL FRAMEWORK

The model of cognitive development on which this project is based has evolved in close connection with the percept-genetic techniques which have been developed in Lund.

Empirical studies of children using one of these techniques, the spiral aftereffect technique, have shown that the youngest children (aged about 4 years) have short spiral aftereffects, while children who are slightly older (about 5 years) have long aftereffects and children aged six have spiral aftereffects of medium duration. This developmental change in the perception of spiral aftereffects is presumed to reflect a change in the child's differentiation between itself and its surroundings. The direction of this change is from a less differentiated to a more differentiated way of distinguishing, on a perceptual plane, between oneself and one's surroundings. The less differentiated approach is expressed either by an exaggerated emphasis of the non-self side (which leads to short aftereffects) or the self side (leading to long aftereffects). The empirically founded pattern of short-long-medium spiral aftereffect duration has become part of an overall model of cognitive development (Andersson, 1977). The main idea behind this model is that a dialectical principle is presumed to govern the interaction of different cognitive systems of action. Originally, tropistic and reflex reactions to stimuli predominate. Dialectic development then progresses further via the predominance of sensorimotor actions vis à vis the world at large to the predominance of perceptual-figural regulations. This is followed by the predominance of conceptual-operational transformations, and the ultimate level is an open cognitive system termed hypothetical construction. The impulse to change through the hierarchy of stages is built into the dialectical triad thesis-antithesis-synthesis. A new system of cognitive action (e g that dominated by conceptual-operational transformations) originates in the antithesis of a

system established at an earlier developmental stage (the sensorimotor in this particular case). The synthesis achieved is qualitatively changed at each level attained. The various syntheses provide the individual with different active strategies for distinguishing between himself and his surroundings.

The sensorimotor terminus is characterized by the child's ability to distinguish between reality and its own actions vis à vis reality, the perceptual-figural terminus by the child's ability to distinguish between actual and apparent reality, and the conceptual-operational by the ability of the teenager to distinguish between reality and his thoughts concerning reality. At the level where hypothetical constructions can occur, the individual is presumed to be free to make use of both objectivizing and subjectivizing devices in order to understand and plan for his future and in order to create a unique relationship between himself, on one hand, and other individuals and his culture, on the other hand.

The aftereffect patterns of adults are understood by means of this developmental frame of reference. Thus a short or long stabilized aftereffect occurring in adults as the result of a series of ten spiral aftereffect trials is presumed to represent a less sharp differentiation between self and non-self factors (within the perceptual-figural system of action). By contrast, an optimum differentiation between these factors gives aftereffects of medium duration in the adult individual. The stabilized duration of spiral aftereffects is presumed to reflect the unique relationship between the individual and his surroundings at a given period of life. This relationship is termed the identity of the individual, and instead of being given once and for all it has to be continuously recreated and confirmed. Because individuals display different identities, a situation which is constructed to "unmask" an individual person's identity must be open in the sense of the individual being able to find and recreate from various alternatives the relationship which is unique to him or her. The spiral aftereffect technique is constructed in this way. The stabilized duration of spiral aftereffects is presumed to be relevant to an understanding of the relationship of the individual to his social and cultural environment in the broad sense.

THE DIALECTICS OF COGNITIVE DEVELOPMENT VIEWED IN RELATION TO THE DEVELOPMENT OF SEXUAL IDENTITY

One fundamental aspect of an individual person's identity, i e his unique relationship to his environment at a given period of life, is his apprehension of his sexual identity and its significance in relation to the social and cultural environment.

My opinion is that the dialectical paradigm can also be used as a metatheoretical tool in order to understand and describe the development of sexual identity. The model on which I base my argument in this connection is inspired partly by Robert Hefner, Medda Rebecca and Barbara Oleshansky (1975) and partly by Alf Andersson's model of the dialectics of cognitive development.

The development of sexual identity can be described as a dialectical triad of thesis, antithesis and synthesis. The impulse to change is built into the triad, which includes factors that are both contradictory and complementary. The development of sexual identity can be described as an ongoing process of development through three stages: Stage I, implying an undifferentiated apprehension of sex roles and sexual identity in early childhood (thesis), Stage II, implying a polarized apprehension of the sex roles and one's own sexual identity, with "male" and "female" regarded as mutual opposites (antithesis), and Stage III, which implies a dynamic transcendence of the traditional sex roles and a traditional apprehension of sexual identity, with the reorganization at a "higher" developmental level of both "male" and "female" aspects of identity (synthesis).

Both psychological theories and the overall organization of society with regard to sex roles are based on Stage II of the model presented here standing for the ideal terminus of the psychological development of sexual identity rather than one stage in a process of ongoing development. I would prefer to argue, in common with Hefner, Rebecca and Oleshansky, that the treatment of this polarity in the apprehension of sex roles and sexual identity as the ideal terminus is a manifestation of the sexual discrimination to which both men and women are subjected in our society, a discrimination which is being increasingly challenged. Discrimination, moreover, produces unequal effects: women are the oppressed and men the oppressors. The sex roles are interpreted as being polar, but the female sex role is considered inferior and subordinate to the male sex role.

Insofar as the model focusses on stages, it is worth-while drawing analogies to other models of developmental stages. Kohlberg's theory of moral development (1964) and Piaget's theory of cognitive development (1970) describe the concrete-operational stage as an advance on the pre-operational stage, but they then go on to describe a third level. In their theories

the third stage is a non-conventional formal-operative stage at which the individual can understand objects as being independent of their own feelings, thoughts, identity etc by employing the principles of formal-operative thinking. In contrast to this, all traditional theories of the development of sex roles and sexual identity (including Kohlberg, 1966) stop short at a conventional, stereotype level.

The model presented here is aimed at expanding the paradigm of sex role learning and sexual identity development beyond both the level of conventional, stereotype, concrete operations and the level of formally logical operations to include a dialectical level at which the individual is free to use both "male" and "female" attitudes. In the model this level is described as dialectical and "open-ended", with no terminus. Here I find it meaningful to draw analogies to the stage of hypothetical constructions described in the model of the dialectics of cognitive development. In that model too, this stage is described as open-ended, having no terminus. The cognitive way of functioning can be described as dialectical, i e the individual is relatively free to employ both objectivizing and subjectivizing cognitive modes in order to understand and plan for his future and for creating unique social and cultural relationships. This stage of the cognitive model is perfectly compatible with the description of a stage transcending the sex roles, at which the relationship between "male" and "female" is a dialectical one.

SEXUAL IDENTITY AND INDIVIDUAL DIFFERENCES

The prime purpose of the project is to investigate identification and problem solving style in relation to women's choices of arts and science subjects respectively at university.

Why do women choose to study arts subjects and men science subjects? Do women go in for science subjects owing to an identity conception of a kind transcending the sex roles, or is their choice a manifestation of denial of their female identity at a profounder level? A Norwegian study points in favour of the latter (Thagaard, 1975). In that study the women who have ventured into typically masculine fields of higher education are described as "more masculine than the men themselves" in terms of interests, values, attitudes and personality. If the latter should also prove to be the case in our study, what are the reasons for such an adjustment? Is this type of conception of identity mainly bound up with the early relationship to parents, or is it an expression of subsequent adjustment to male-dominated scientific training and instruction? A survey report which has been published concerning girls leaving the Natural Science line of upper secondary school (IAN-rapport nr 191) shows that this type of

problem presumably operates in two ways, if not more. One of the interesting findings in this connection was that most of the girls who dropped out considered themselves more similar to their mothers than those who stayed on. The girls who stayed on reported two patterns of adjustment; some of them considered themselves different from both their parents, while others considered themselves as having most in common with their fathers. One hypothesis is that both the latter categories include both girls who, in response to the demands of their environment, have reconstructed their sense of identity in a manner which tends more to transcend the sex roles and, secondly, girls who have adopted a non-autonomous identity for defensive purposes. The latter can amount to a denial of one's own female identity at a profounder level.

If our investigations should corroborate hypotheses of this kind and perhaps even show that a large proportion of the women going in for science subjects display a type of defensive adjustment of the kind we have described, this must be taken to indicate that scientific instruction and education are hard to reconcile with an autonomous female conception of identity. In this case, instruction and education will first and foremost have to be transformed in such a way as to enable women in these fields to experience education as compatible with a female autonomous identity, which of course would also facilitate the recruitment of women in these fields.

Do women opt for arts subjects as a manifestation of non-autonomous identity, since arts subjects are a traditional feminine choice? Or is the study of arts subjects more compatible than the study of science subjects with an autonomous apprehension of identity transcending the sex roles? Our previous investigations point in favour of the latter alternative. It was mainly among the arts students that we found individuals who were independent and imaginative, not among the science students. In this case one is inclined to infer that science subjects as organized at present provide little (too little?) scope for independence and imagination, at least at lower educational levels.

Both the models referred to, the cognitive model and the model of sex role transcendence, incorporate a dynamic and flexible apprehension of identity. As has already been pointed out, the identity of an individual person is not given once and for all but has to be

continuously recreated and confirmed in relation to his surroundings. Moreover, working with the sexual identity problems of an adult individual in order to promote an autonomous development of identity transcending the sex roles is something explicitly advocated in the model of sex role transcendence, together with necessary parallel work on a social plane. Thus an investigation of this kind could be followed up directly with practical pedagogical work among both teachers and pupils at elementary school, upper secondary school and post-secondary levels. The same applies to creativity problems, which I shall be considering more closely later on.

THE DIALECTICS OF COGNITIVE DEVELOPMENT, VIEWED IN RELATION TO CREATIVE COGNITIVE DEVELOPMENT

The model of cognitive development which has been presented can also be used in describing creative cognitive functioning. Dominant theories of cognitive development, e g Piaget's, describe the alienation of thinking from its creative, dialectical basis. In this respect the theory represents the goal of our higher education system, which in turn reflects the non-artistic and non-creative aspects of the intellectual history of western man (or rather, western men). Although Piaget's theory rests on dialectical foundations (the dialectical interaction of what he terms "assimilation" and "accommodation"), Piaget does not follow up this dialectical paradigm in his description of the level of operations, either as regards the concrete-operational level or the formal-operative level. In this way he cannot really correctly reproduce the thinking of human adults, which only operates at a formal-operative level in exceptional cases. Creative scientific activity, for example, is dominated by playful manipulations of contradictions and by an integration (synthesis) of concepts and contexts which have been split up by formal-operative thinking. The same type of intuitive querying of the "law and order" of thinking is still more distinctive of the levels of cognitive activity which function at a "lower" developmental level than of formal-operative intelligence.

As has already been made clear, a further stage of development, termed the level of hypothetical construction and succeeding the level of concrete and formal operations, is proposed in the model presented here. This level represents a step forwards in development (compared with concretely and formally operative functioning), but at the same time it implies a reversion to the principles of thinking which predominated at earlier developmental levels (pre-operational, i e perceptual-figural regulation and also sensorimotor functioning, which is dialectical by nature). Creative cognitive functioning implies that the individual has access to lower functional levels without being restricted by them.

The functional level at which an individual prefers to function and the access he/she has to different functional levels will depend on his/her "concealed mental organization". When this aspect is emphasized, the perspective changes from one concerning general developmental principles only to one which also includes differences of personality. The advantage of the model outlined here is that it permits such a differentiated conceptual image of personality (identity and the strategies used for the retention of identity according to Andersson's frame of reference) and individual differences. This is not possible with Piaget's and Guilford's models.

RESEARCH AND CREATIVITY

Most creativity tests are of the kind presented in the introduction, i e tests of "divergent" and "convergent" ability respectively. In view of the model of the dialectics of cognitive development which has been outlined here, the percept-genetic techniques must be considered more serviceable when it comes to "unmasking" the "concealed mental organization" of the individual, i e how he/she prefers to work and at what functional levels.

Few studies have been made of scientific creativity in Sweden, but a minor study based on percept-genetic theory and method was carried out recently (Smith & Danielsson, 1977). The group of researchers investigated comprised 9 biologists (7 men and 2 women) and 9 arts specialists (7 men and 2 women), most of whom had Ph.D.s. They had been selected by an older scientific leader of good repute in their various fields. In addition to percept-genetic techniques, the methods used included ratings by independent observers according to nine different criteria, together with an interview.

The rating criteria are particularly interesting on account of the insufficient light which has been shed on the problem of criteria regarding creativity in research. The ratings were made by superior tutors in each field who were closely familiar with the researchers examined and with their research work. The observers were asked to state which of the researchers in the study deviated in a positive sense from the following criteria.

(1) Abundance of ideas (regardless of their originality or usefulness)

(2) Originality (with regard to the best ideas, irrespective of quantity)

(3) Productivity (in terms of the amount of research completed per unit of time, no allowance being made for abundance of ideas or originality of thought)

(4) Ability to organize research work efficiently

(5) Ability to communicate findings clearly and succinctly

(6) Verbal ability referable to linguistic flexibility and variability (irrespective of pedagogical lucidity)

(7) Critical acuity

(8) Emotional involvement in research (treating research as a calling rather than just another job)

(9) Independence

The three variables of sex, Ph.D. and research field were also used.

The following five types of researcher were found in the investigation.

Researcher I is productive, has the knack of organizing his/her work, has critical sense but is dependent on other people's ideas. His/her research is of a "recreative" kind. This person feels no anxiety or anguish and is able to conceal his/her feelings.

Researcher II has ideas of his/her own and many of them, has verbal ability and critical acuity, is independent and creative but not necessarily particularly efficient or productive. This researcher is closely identified with his/her work, experiences happiness but is also anxious in case he/she should run out of ideas. He/she is conscious of an inner, subjective dimension as the ultimate source of his/her new creativity.

Researcher III is the "ordinary" researcher, lacking both ideas, creativity and the ability to organize his/her work, but coping with the practicalities of research. He/she has no powerful links with research, and his/her feelings are under control.

Researcher IV lacks critical acuity, has no abundance of ideas and has no organizing ability

either, but he/she is a skilled teacher and can communicate scientific findings. Research is not the "true" life; rather it is used for defensive purposes, as a counterpoise to overwhelming feelings.

Researcher V — is potentially creative but neurotic and at times handicapped in his/her work for this reason. Although this researcher is creative and emotionally committed to his/her work, he/she cannot derive any pleasure for it, thereby differing from Researcher type II.

This investigation is based on a small number of researchers (18). The second purpose of the project is to study a larger group of researchers, partly in order to see whether the findings are more generally valid but also in an attempt to elucidate at individual level the bearing which the researcher environment has on creativity.

Whether or not a researcher will function creatively depends not only on his/her personality but also on the demands and opportunities entailed by the environment in which he/she lives and works. The type of researcher given priority in various contexts at present is undoubtedly the efficient and energetic but not very creative type. This type of researcher is used as a paragon in the administration of research and research training, to the detriment of the research which is genuinely capable of advancing the so-called forefront (Smith & Danielsson, 1978). A further dilemma concerns women researchers who meet with overt or covert discrimination or who do research in a predominantly male institution or research field. Stiff external resistance can create in these women an anxiety which is combined with their female identity and can force them into a strategy of adjustment whereby they deny their identity on an unconscious plane, thereby depriving themselves of the subjective basis of creativity.

Problems of another kind are raised by the studies which we made of arts and science students and which we referred to by way of introduction (see page 1). We found that the most imaginative students went in for arts and science subjects. We are not alone in these findings; both Liam Hudson in England and a broad-based study in Norway have come up with similar findings, namely that

creative and imaginative students primarily choose arts and social science subjects at university, while the efficient and energetic but non-creative students opt for natural sciences and technical subjects (Hudson, 1967, 1968; Thagaard, 1975). It is not certain whether the same polarization applies at research level, and this point will be investigated in the course of the project.

PURPOSE

As should already be clear, the purpose of the project is to study the following two problems.

(1) Identification and style of problem solving in relation to the choice by women of arts subjects and science subjects respectively at university.

(2) Identification and style of problem solving in relation to research focus and research ability.

ACTIVITIES CONDUCTED

The project has now been in progress for six months (on a half-time basis). The results of the work so far have been published in a preliminary working report (in Swedish) entitled "Identification and style of problem solving in relation to the choice by women of arts and science subjects respectively at university". The findings thus presented are only preliminary ones, based on frequency analyses, and they may be revised as an effect of independent double coding and statistical analysis, but the results which have been obtained so far support the hypotheses underlying the investigation.

Thus the science group has a greater predominance of individuals orienting themselves towards objects or non-self-related factors in their field of experience during the ten spiral aftereffect trials, while the arts group includes more individuals orienting towards subjects or self-related factors in their field of experience. The arts group also does better than the science group in problem solving tests requiring imagination, while the science group does better in problem solving tests which leave no scope for imaginatively based solutions. This may perhaps be taken as indicating that the strategy employed by humanists and scientists respectively in order to establish the social and cultural relationship they prefer vis à vis their environment is also related to the cognitive strategy they prefer to employ when solving problems.

The other findings also serve to show that an individual person's identity apprehension and the way in which he/she arrives at that apprehension can be important in connection with problem solving. Thus we find a slight but unmistakeable predominance among scientists of women considering themselves most similar to their fathers,

while among the arts specialists we find a correspondingly slight predominance of women considering themselves most similar to their mothers. Moreover, the integration of pregnancy with female identity appears to be more of a problem to female scientists than to female humanists. Fewer women scientists gather that a thematic picture presented using the DMT technique (i e gradually increasing short-time exposure of the picture in a tachistoscope) represents a pregnant woman. Among those women scientists who do gather as much, the number arriving at a correct apprehension of the picture is smaller than among the arts students and there is even a difference between the groups regarding those who apprehend the picture correctly. Those members of the science group who arrive at a correct apprehension of the picture do so later than the corresponding category among the arts students.

The greater problems encountered by the female scientists in connection with the picture of the pregnant woman are not necessarily bound up with their early childhood and adolescence, or at least not solely with this factor. It is equally obvious that for a long period of their lives they have gradually adjusted to instruction and education based entirely on the terms dictated by masculine society, which means that pregnancy, childbirth and child care are not integrated as natural human phenomena which ought to involve men and women equally. Being a woman in an educational community tailored for men who are never expected to look after their own children or other people's, a community in which nobody is expected to become pregnant, must entail problems even if the problems are never consciously acknowledged. Although the thematic picture clearly presents more of a problem to the science group than to the arts group, there were few women scientists who believed that any children they might have would be a problem to them later on. Most of them were in fact intent on having children sooner or later. This transpired from the interview, which will be analysed and presented in the next working report.

ACTIVITIES INTENDED

The next stage will involve completing the analysis of the first investigation and collecting the findings in a final report. The next investigation will then be carried out. The timetable will be as follows.

TASK	TIME
Investigation 1	Spring term 1979, half time
	Autumn term 1979, full time
Investigation 2	Spring term 1980, half time
	Autumn term 1980, full time
	Spring term 1981, half time
	Autumn term 1981, full time

SIGNIFICANCE

The initial purpose of the project is to investigate whether the model of cognitive growth and development which has been presented is viable frame of reference and explanatory system for the description of an identity apprehension transcending the sex roles and of creative, cognitive functioning. If the model works, this will also hold practical implications for work to promote equality between the sexes in higher education and for research policy decisions concerning the type of research and the types of researchers to be encouraged now and in future.

Margot Bengtsson

1979-10-03

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